

# MONTHLY WEATHER REVIEW,

## JULY, 1876.

WAR DEPARTMENT,

Office of the Chief Signal Officer.

DIVISION OF

TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE AND AGRICULTURE.

### INTRODUCTION.

The following is a general summary of the meteorological data collected in the Office of the Chief Signal Officer of the Army during the current month. The regular tri-daily charts, containing the data of the simultaneous observations taken at ninety-two regular and thirty-eight special Signal Service stations, and fourteen Canadian stations, have been carefully examined, together with monthly journals and monthly reports from four hundred and ten stations classified as Voluntary Observers, Army Post, and Signal Service Stations.

These stations are geographically distributed as follows: Alabama, five; Arizona, ten; Arkansas, four; California, three; Colorado, five; Connecticut, five; Dakota, six; Delaware, two; District of Columbia, one; Florida, seven; Georgia, ten; Illinois, twenty; Indiana, eleven; Indian Territory, one; Iowa, twenty; Kansas, fifteen; Kentucky, six; Louisiana, five; Maine, eleven; Maryland, nine; Massachusetts, twenty; Michigan, thirteen; Minnesota, eight; Mississippi, four; Missouri, five; Montana, two; Nebraska, nine; Nevada, one; New Hampshire, eleven; New Jersey, twelve; New York, thirty-six; North Carolina, seventeen; Ohio, twenty-one; Oregon, one; Pennsylvania, twenty-three; Rhode Island, two; South Carolina, three; Tennessee, seven; Texas, fourteen; Utah, two; Vermont, six; Virginia, sixteen; West Virginia, three; Wisconsin, ten; Wyoming Territory, two.

In comparing these records with those of a corresponding period of previous years, the most marked conditions are, *first*—the continued high temperature during the greater portion of the month throughout the United States east of the Rocky Mountains, the heat in many places becoming so intense as to produce fatal results, to cause the suspension of business, and an increase of the death rate of many of the large cities to the highest reported percentage; *second*—the absence of well-defined barometric depressions, the excess of pressure on the South Atlantic coast and in the Gulf States; *third*—the destructive tornadoes which occurred in Iowa on the night of the 4th, attending the depression marked as No. II on the storm chart; *fourth*—the floods in the Red river, which were very destructive to the cotton crop between the Red River Raft and Fulton.

The month has proved generally favorable to the agricultural interests of the country, although local droughts occurred in the Middle States, followed at the close of the month by an excess of rain. The heavy rains in the South Atlantic States and in the Missouri and Ohio valleys resulted in destructive floods, which injured the growing crops on the bottom lands. Reports from over two hundred stations in Indiana, Illinois, Kentucky and Tennessee, show that heavy rains in these regions have reduced the grain crops below the average.

## BAROMETRIC PRESSURE.

*In General.*—The mean barometric pressure of the month is shown, by the black lines, on Chart No. II, from which it will be seen that the area of mean high barometer is now located near the southeastern portion of the United States, the isobar of 30.05 extending as far west as the Mississippi river. Compared with the preceding month, this chart shows an advance of this area to the west, while in previous years the pressure has continued lower during July in the southern portion of the country. This increase of pressure, considered with reference to the distribution of pressure in the northern portions, favored the continued flow of air to the regions of low barometer, and will account for the mean direction of wind at the several stations, as indicated by the arrows on the chart. The region of mean low barometer continues near the centre of the continent, with a slight increase of pressure over that of the previous month. Considering the whole chart, there has been an apparent atmospheric movement from the Atlantic coast to the westward, except in New England. The distribution of pressure on the Pacific coast continues as in the previous month, the mean at Portland, Or., being 30.06, while at San Francisco and San Diego no change has occurred. The barometric range has, as usual, increased with the latitude, the greatest being at Pembina, 1.54 in., Bismarck, 0.91, North Platte, 0.83, Duluth, 0.80, St. Paul, 0.70, and the smallest, Key West, 0.19, San Diego, 0.25, Galveston, 0.28, Memphis, 0.32, Nashville and Cairo, 0.33.

*Areas of High Pressure*—No. I.—This extended area continued central near the South Atlantic coast from the 1st, to the afternoon of the 7th, when it passed to the south of this region, causing a general decline of pressure on the Atlantic coast, and an increase in the Lower Mississippi valley. During the 8th, 9th, and 10th this area disappeared to the south of the Gulf coast, but the pressure continued sufficiently high to cause a continuance of the warm and dry, south and southwest winds at the station to the east of the Alleghanies. The retarded movement of this area on the southern coast, with occasional partial depressions in the Northwest, accompanied the high temperature which continued uninterruptedly until the distribution of pressure was changed by the advance of an area of high barometer from the Northwest on the 13th. On the morning of the 10th the pressure had increased in the Upper Lake region and the Northwest with cooler northerly winds and local rains, and, during the day, this increase gradually extended towards the coast, resulting in the formation of a second area over the Southern States. This second high pressure, on the coast, continued almost stationary until the 13th, and disappeared during the 14th and 15th to the south of the Gulf coast.

No. II.—The afternoon telegraphic reports of the 13th, indicated the advance of this area from the region west of Hudson's Bay, and by midnight of the 14th, the temperature had fallen in the entire Lake region. This area moved toward the middle Atlantic coast and thence southwestward over the Southern States, but was accompanied by only a temporary depression of temperature.

No. III.—was observed in the region north of Fort Garry on the afternoon of the 20th, the barometer at this station reading 30.18. It moved rapidly over the Lake region to the Atlantic as an area of 30.10, and disappeared in advance of the depression marked as No. VI on the chart.

No. IV.—approached from the extreme Northwest on the 21st, and continued central in this region until the 25th. Although there is no well-defined movement of the area from the Northwest to the coast, its presence is indicated by the gradual increase of pressure over the districts east of the Mississippi during the 26th, and 27th. The study of the movements of this area is more interesting, as it accompanied the final interruption of the protracted term of high temperature.

*Areas of Low Pressure.*—No. I.—This depression was referred to in the June Review as No. VII, and partially described. On the morning of the 1st, it was central in Northern Missouri, and the region of heavy local rains had extended eastward over Lake Erie and the States north of the Ohio valley. The isobars of the succeeding charts show an advance towards the coast, while the central area continued almost stationary in the Northwest. The track given on the chart is only an approximation of the movement, which, at no time, was well-defined. A second depression developed in the extreme Northwest, and apparently passed north of the Lake region during the 2nd, and 3rd, accompanied by light rains. Reports from the stations west of the Mississippi indicate that this storm developed near the east slope of the Rocky Mountains, as severe local storms were reported in the regions south of the Platte and Missouri rivers. Disastrous freshets occurred in the streams crossed by the Iron Mountain railroad and in Indian Territory, causing delay in trains.

No. II.—is first noted on the chart as central near the mouth of the Platte river on the morning of the 3rd, and advanced during the succeeding eight hours to northern Illinois, accompanied by local storms; those in the Missouri valley being most severe, and in some cases unroofing houses. The midnight report of the 3rd,

shows no well-defined atmospheric movements, and that the region of lowest pressure had apparently receded to the Missouri valley, while the rain-area had extended from the Lower Lake region to the Ohio valley. The pressure continued low in the Missouri valley on the 4th, with a gradual movement towards the northern portion of Iowa, where it was central at midnight. Tornadoes occurred in the southeast quadrant of this depression, in the counties of Lee, Davis, Van Buren, Clark, Lucas, Appanoose, Harrison, Delaware, Jones, Linn and Cedar, causing great loss of life and serious injury to crops. The storm was particularly severe at Dubuque, and at Rockdale, thirty-nine persons were drowned by a flood in the small stream upon which the village is located. Further reports show that this storm extended southward into Missouri during the 4th and 5th. Over four inches of rain fell at Keokuk, causing floods in the Des Moines river. On the morning of the 5th, this storm was central near Chicago, with a well-defined circular area of 29.60, two hundred miles in diameter; the wind had shifted to the north and northwest at Milwaukee and Chicago, with increasing force, and light east to south winds continued in the eastern portion of the Lake region. The P. M. reports of the 5th, show a rapid advance of the centre to the east, accompanied by violent gales and heavy rains on the Lower Lakes, and a tornado in the valley of the Alleghany. This storm proved particularly severe at Erie and Buffalo, and, after the wind veered to the west, the water in the eastern portion of Lake Erie rose five feet above the mean. The progressive movement of this depression was less rapid over the Lakes and the St. Lawrence valley, but increased after passing over northern New England. Heavy gales were reported in the St. Lawrence valley and east of Nova Scotia on the 5th.

No. III.—This depression is not traced upon the chart, as its track passed north of the Lake region from the 5th, to the 9th, accompanied by warm and generally clear weather east of the Mississippi, except a very heavy local rain in the central Ohio valley, and a severe wind-storm near Macon, Ga., on the 6th. Local rains continued in the Northwest, and there was a gradual decline in the barometer in the eastern districts on the 10th, accompanied by a corresponding rise in the Northwest. The local rains due to the sudden shifting of the winds produced only slight changes in the unusually high temperature.

No. IV.—a partially defined depression in the Lower Missouri valley, on the morning of the 13th, which moved eastward during the day as an area of rain, extending over the States of the Ohio valley, Virginia and Pennsylvania. The barometer continued to fall in the eastern districts, but the central depression became so extended and ill-defined as to render its movements uncertain and without special interest. Severe local storms and heavy rains occurred in Tennessee, North Carolina, Virginia and the Ohio valley during the 13th, and 14th. Freshets occurred in the upper Ohio river near Pittsburgh and in middle and southern Ohio, causing damage to crops, fencing, railways, &c.

No. V.—approached gradually from the extreme Northwest during the 17th, and 18th, and was marked central near Bismarck on the morning of the 19th. The track of this depression is shown by the dotted line upon the chart passing to the north of the Lakes. The centre of this depression was so far to the north as to render it impossible to accurately trace its movements. On the 20th, the belt of light rain extended as far south as the Gulf States, and as the depression approached the St. Lawrence valley the disturbance increased along the Atlantic coast, the winds shifting to westerly, with a sudden fall in temperature. On the night of the 20th, a violent tornado occurred in the vicinity of Richmond, Va., but numerous reports show that, although severe, it was entirely local in its nature. Numerous storms occurred during the night of the 20th, in Pennsylvania and New Jersey, one specially noted at Philadelphia.

No. VI.—At midnight on the 21st, this depression was central south of Breckenridge, and during the preceding eight hours the barometer had risen rapidly at Pembina with a decided fall of temperature; the region of high temperature and southerly winds extended southward to the Gulf coast and westward over the Territories. During the succeeding eight hours the central area passed rapidly east to the northern portion of Lake Michigan, accompanied by heavy rains and brisk winds at the northern stations. At Alpena the wind had increased to a velocity of twenty-eight miles per hour from the south, and to the west of Michigan the barometer had risen rapidly, with cooler, northerly winds, which gradually extended over the districts east of the Mississippi, as this depression advanced to the coast. After reaching Lake Michigan the course changed to the southeast and so continued until the storm passed beyond the limits of our stations. As the disturbance moved eastward the isobar of 29.90 became more extended and the barometer fell below 29.80 at the stations between Wilmington and Portland, Me. Heavy rains occurred as far south as Wilmington and on the immediate coast to the north, where the winds increased to brisk, and, in some cases, high, after veering to the northwest.

No. VII.—was at no time within the limits of the stations, but passed eastward, following the general course of the Lakes and St. Lawrence valley, accompanied by heavy rains in the Ohio valley, Tennessee and thence eastward to the coast. Marine reports show that dangerous winds occurred on the Lower Lakes



on the 27th, and on the Middle and East Atlantic coasts on the 28th. Cautionary Signals were ordered for the Lake ports and on the Atlantic coast from Wilmington to Eastport, but they were not generally justified at the stations.

No. VIII.—This depression, although slight, apparently developed in the Ohio valley, while a second depression was central west of the Mississippi and south of the Missouri. A tornado occurred near St. Louis, Mo., on the morning of the 28th, extending over an area of twenty miles, and proving destructive to crops and buildings. The record of the wind-velocity at the St. Louis station shows the proximity of this disturbance, and that it was of a local character. The region of rain gradually extended to the east and south, with no decided change in the barometer, and a greater portion of the rain of the month fell at the stations in the Middle Atlantic States and near the New England coast on the 29th, 30th, and 31st, while this depression moved southeastward, and passed off the South Atlantic coast.

## TEMPERATURE OF THE AIR.

*In General.*—The temperature has averaged high during the month, especially in the districts east of the Mississippi, and was in no case below the normal, except on the Pacific coast. Comparing chart No. II with that of the previous month, it will be seen the isothermal line of 80° has moved north from the Gulf coast, and approximately follows the 37th parallel between the Alleghany Mountains and the eastern slope of the Rocky Mountains. East of the Alleghanies this line follows the course of the range to the head of the Chesapeake Bay. The isothermal lines of 75° and 70° are deflected to the north as they approach the coast, the latter including within its area a greater portion of the St. Lawrence valley. The influence of the ocean temperature is well marked in the higher latitudes on the eastern coast by the sudden deflection of the isothermal lines 75°, 70° and 65° to the south. It will be seen from the table that the greatest variations from the mean are, +4° 5 in the Lower Lake region, and about +3° in the Middle and Eastern States. Compared with July, 1875, the month has been decidedly warmer in the northeastern districts, and a lower mean prevailed in the Gulf States and Southwest. Compared with July, 1874, the temperature has been lower in the Mississippi, Missouri and lower Ohio valleys. On the Pacific coast the temperature has averaged 69° at San Diego, 59° at San Francisco and 67° at Portland, Or., or only a difference of 2° in temperature for 12° of latitude. Daily reports from the Signal Service telegraph stations in Arizona gave temperatures ranging from 100° to 110° at the observation taken at 4:35 p. m., Washington time.

*Maximum Temperatures.*—The highest temperatures for the month have occurred as follows: Baltimore, Cape Henry, New York and Washington, 99°; Bismarck, Denison, Lynchburg, Philadelphia, Sandy Hook and Tybee Island, 100°; Denver, Jacksonville, Montgomery and Pittsburgh, 101°; North Platte and Norfolk, 103°; Corsicana, 105; Dodge City, 108°.

*Minimum Temperatures.*—Temperatures below 47° have been reported as follows: Pembina, 46°; Bismarck, Alpena and Colorado Springs, 45°; Cheyenne and Marquette, 44°; Denver, 43°; Wytheville, 42°; Virginia City, 39°; Mt. Washington, 32°; Pike's Peak, 18°.

*Ranges of Temperature.*—The greatest ranges of temperature for the month are: Denver, 58°; Bismarck, Dodge City and North Platte, 55°; Marquette, 54°; Alpena and Cheyenne, 52°; Wytheville, 51°; Colorado Springs and Virginia City, 50°. The smallest ranges have been: at New Orleans, 17°; San Diego, 18°; Key West, 19°; Galveston, 21°; Cape Lookout and Mobile, 22°; Cape May, Indianola and San Francisco, 25°.

## PRECIPITATION.

The quantity of rain-fall has generally been an excess, compared with that of previous years, although there is a deficiency reported in the Western Gulf States and Upper Missouri valley. Chart No. III appears more irregular than usual, but the distribution of rain-fall does not materially differ from that of the previous month. The areas of over ten (10) inches in the South Atlantic States diminished and moved southward, as is usual, with the advance of summer. A large excess occurred in the Lower Missouri valley, the area extending northward over Iowa and the western portion of Illinois. An excess occurred a little south of the Lake region, which corresponds to a similar excess shown on the chart of the previous month. In comparing the rain-fall in the Lake region with that occurring in the districts east and west of it on the same latitude, it will be seen that the evaporation from these large bodies of water does not increase the precipitation in this region, although the number of days upon which rain falls is greater. Compared with July, 1875, the rain-fall has been more generally distributed; the large area of drought in the Gulf States during that year having received a rain-fall of from four to ten inches. A slight excess of rain occurred on the Pacific coast, but the average for the three stations amounts to only 0.33 inches, while no measurable quantity fell at San Diego.

**Rainy Days.**—The number of days on which rain fell during the month varies from 11 to 17 in New England; 10 to 18 in the Middle States; 9 to 21 in the Southern States east of the Mississippi; 9 to 13 in the Southwest; 9 to 18 in the Lake region; 14 to 17 in the Ohio valley; and 8 to 15 in the Northwest.

**Fog.**—Fog has been frequent only on the coast of New England and at San Francisco.

**Heavy Rains** are reported as follows: Baltimore, 3.14 in. on the 30th; Charleston, 4.87, 16th, and 3.01, 24th; Dubuque, 4.55, 5th; Keokuk, 5.28, 4th and 5th; New Haven, 7.15, 30th and 31st; Newport, 3.45, 23d; Savannah, 3.56, 24th and 25th; Tybee Island, 4.50, 30th; Washington, 4.12, 30th; Southington, Conn., on 30th and 31st, 4.10; Middletown, Conn., on 30th and 31st, 5.75; Riley, Ill., 10th, 3.50; near Independence, Iowa, heavy rain on 4th, damaging railroads, &c.; Ames, Iowa, 1.66 in one hour, 4th; Stanley, Kan., wind and rain-storm 28th, damaging crops, fruits, &c.; Mendon, Mass., all the rain of month, 5.40, fell on 23rd, 30th and 31st; Worcester, Mass., from 3:46 p. m., 30th, to 7 a. m., 31st, 4.55; Waltham, Mass., 4.04 during 24 hours ending 3:40 p. m., 31st; Wet Glace, Mo., 3.90, 12th, and 3.40, 15th; "cloud bursts" in Nevada; at Gold Hill, 22nd and 24th, Genoa 20th, Eureka, 24th; Snowville, Va., 4.7 on 21st, causing damaging floods.

**Snows.**—Snow occurred at Pike's Peak on the 14th, 15th and 18th; Mt. Washington, 25th and 26th. Carson City, Nev., snowing on mountains on 7th.

**Drought.**—Rain needed at Mt. Desert, Me., 21st; drought, May 10th to July 22d, Fall River, Mass.; fruit injured by drought and springs low, Litchfield, Mich., 21st; month dry, vegetation scorched, Minneapolis, Minn.; rain needed for corn and cotton crops, Brookhaven, Miss., 31st; crops much damaged by droughts, Richmond, Neb., 31st; drought until 20th, Auburn, N. H.; drought from June 20th to July 22d, Newark, N. J.; drought to 29th, New Germantown, N. J.; very little rain from June 5th to July 23d, Brookhaven, N. Y.; drought very severe at North Hammond, N. Y., 17th; at Kensico, N. Y., crops suffering for rain first part of month; Stapleton, drought June 21st to July 11th; Flushing, N. Y., no rain until 10th; Farmingdale, N. Y., drought until 30th; Nottaway, Va., drought until 10th; Lynchburg, Va., drought very severe, from June 25th to July 28th; Newport, R. I., drought until 23d.

**Hail.**—2nd, Mendon, Mass.; Ringgold, Ohio; 3rd, Afton, Iowa; 4th, DeSoto, Neb.; 6th, Rockford, Iowa; 7th, Mt. Auburn, Ohio; 9th, Middletown and New London, Conn.; 13th, Richmond, Neb., Le Roy, Wis., Pike's Peak; 14th, Shelburne, N. H., Pike's Peak, 17th, near Nora Springs, Iowa, Genoa, Neb.; 18th, 22nd and 23d, Pike's Peak; 25th, Buffalo, Rochester and Denver; 26th, Cornish, Me., Pike's Peak; 28th, Afton, Iowa; 29th, Durham, Ark., Purdy, Tenn.

## RELATIVE HUMIDITY.

The relative humidity, as reported from the Signal Service stations, averages from 68 to 82 per cent. at the stations on the New Jersey and New England coasts; from 61 to 71 at the stations in the interior of the Middle and Eastern States; from 65 to 77 in the Southern States and Ohio valley; from 68 to 78 in the Lake region; and from 65 to 75 in the Upper Mississippi and Lower Missouri valleys. It is, as usual, lowest on the western plains and the Rocky mountains, being 54 at Bismarek, Dak., and North Platte, Neb., 48 at Colorado Springs, 39 at Denver, 35 at Cheyenne, and 30 at Salt Lake City. The mean of Pike's Peak is 78 and that of Mt. Washington 90.

## WINDS.

**Prevailing Winds.**—The prevailing winds for the month are shown by the arrows on Chart No. II. They have been mostly from the south or southeast in the Gulf States, and Lower Missouri valley; from the south or southwest in the South Atlantic States, Tennessee, the Ohio valley and New England, but have been more variable in the Middle States, the Lake region and the Upper Mississippi valley.

**Total Movements of the Wind.**—At the Signal Service Stations, the largest monthly movements are, as follows: Mt. Washington, 23,762 miles; North Platte, 12,242; Cape Lookout, 12,020; Dodge City, 11,311; Fort Sully, 10,173; Breckenridge, 9,993; Pike's Peak, 9,456. The smallest total movements are: Wytheville, 2,025 miles; Lynchburg, 2,244; Augusta, 2,320; Nashville, 2,569; Burlington, Vt., 2,739; Shreveport, 2,837; Vicksburg, 2,851. These figures plainly indicate a region of very high winds in the western portions of Kansas, Nebraska, Minnesota, and southwestern Dakota, and an extensive region of light winds in the interior of the Southern States.

**Highest Winds.**—Among the highest wind-velocities reported from the Signal Stations are the following: Bismarek, 19th, NW., 56 miles per hour; Buffalo, 5th, SW., 60; Breckenridge, 44; Cape May, 4th, W., 48; Denison, 8th, 40; Dodge City, 3rd, S., 46; Escanaba, 56; Fort Sully, 4th, 54; Indianola, 14th, 55; Mt. Washington, 84; North Platte, 7th, 57; Pike's Peak, 8th, 50; Philadelphia, 20th, 40; Port Huron, 5th, 46; St. Paul, 6th, 54; Sandy Hook, 11th, NW., 50; Toledo, 5th, 40.

*High Winds* generally attending thunder-storms are also reported by Voluntary Observers as follows: Fort Madison, Iowa, damaging wind-storms, 3rd; Ames, Iowa, severe wind-storm, 4th; Stanly, Kansas, severe and destructive storms of wind and rain, 28th; Fallston, Md., severe wind-storm, 11th; Carthagena, Ohio, 20th; Newport, Vt., strong gales, 20th; Neillsville, Wis., severe wind-storm, 17th.

*Tornadoes* occurred at Spiceland, Ind., blowing down trees, &c., 4th; Nottaway and Norfolk, Va., 13th. A *whirlwind*, with a storm of grasshoppers, was observed on Pike's Peak on the 11th.

## VERIFICATIONS.

*Probabilities.*—The usual comparison of the tri-daily Probabilities, with the data contained in the three succeeding reports, gives 86.4 as the general average percentage of verifications. The percentage for each district is as follows: New England, 86.2; Middle States, 87.4; South Atlantic, 84.3; Eastern Gulf, 88.2; Western Gulf, 90.3; Lower Lakes, 87.8; Upper Lakes, 83.9; Tennessee and the Ohio valley, 83.2; Upper Mississippi valley, 88.7; Lower Missouri valley, 85.5. The percentage of verifications for each element is as follows: weather, 92.4; winds, 88; temperature, 86.1; barometer, 78.

The observer at Nashville reports that the storm of the 21st, caused dangerous floods in the small streams of the vicinity, and that warning was given by the "Farmer's Bulletin" which enabled the farmers to secure exposed grain and other property.

*Cautionary Signals.*—Forty-three Cautionary Signals were displayed at the regular Signal Service Stations, of which twenty-three were justified by the occurrence of dangerous winds at or near the stations. Signals were ordered for the severe storm of the 4th and 5th, on the Middle Atlantic and New England coasts, but were not ordered for the stations on Lakes Erie, Michigan and Huron.

## NAVIGATION.

*The stage of water.*—The highest and lowest readings on the Signal Service river gauges are given in the table on chart No. III. In the Red river, at Shreveport, the highest reading, 29 ft. 5 in., is four inches below the "danger line" of the Signal Service gauge, which occurred on the 28th. Dangerous floods occurred above this point, injuring the cotton crop; and the Observer at that station reports on the 22d, that the heavy rise during the last day of the week came out of the lakes of that vicinity, while the river above was falling. The Mississippi was highest at Vicksburg on the 23d, when it was 40 ft., or 1 foot below the "danger line." The upper Mississippi declined during the entire month, and was lowest on the 31st. The Missouri was highest at Leavenworth on the 6th, and lowest on the 31st. Freshets occurred in the Upper Ohio, near Pittsburgh, in the Des Moines, near Keokuk, and in the Yazoo, near Vicksburg. The observer at Portland, Or., reports that "the river, which at the commencement of the month was in the streets of Portland, has fallen quite rapidly and is now about fifteen feet below high water mark."

## WATER TEMPERATURES.

A table at the lower right-hand corner of the chart, No. II, gives the maximum and minimum temperatures of water as observed at the stations named, the third column gives the depth at which the observations were taken. The range of temperature was greatest at Duluth, 26°; Memphis, 23°; and least at Jacksonville, 3°; Mobile and Eastport, 4°. The average temperature of water on the Gulf and South Atlantic coasts was slightly above the mean temperature of the air, while on the Middle Atlantic and New England coast it was slightly below the temperature of the air.

## ATMOSPHERIC ELECTRICITY.

*Auroras*—have been observed on the following dates—that of the 16th being generally visible in the northern sections of the country, extending from Maine to Iowa; the reports are as follows: 8th, Litchfield, Mich.; 10th, Afton, Iowa; 12th, and 15th, Duluth; 16th, Detroit, Oswego, Port Huron, Rochester, Mt. Washington, La Crosse, Springfield, Marquette, Alpena, Grand Haven, Coresco, Iowa, Gardiner, Me., Auburn, N. H., Manitowoc, Wis.; 17th, Duluth, Gardiner, Me.; 18th, Malone, St. Paul, Escanaba, Marquette, Alpena, Minneapolis, Minn.; 19th, Alpena, Gardiner, Me.; 20th, St. Paul; 21st, St. Paul; 23rd, Fort Pembina; 25th, Malone, Gardiner, Me.; 29th, Boston, Rochester, Marquette, Dodge City, Breckenridge; 30th, Rochester; 31st, Rochester, South Hartford, N. Y.

*Thunder and Lightning.*—Local storms, accompanied by thunder or lightning, occurred in all the districts, and in a number of cases were destructive to property and life. Electrical displays were more numerous between latitudes 36° and 46°. Chronologically arranged, the reports are as follows: 1st, Fla.,



Ill., Ind., Kan., La., Miss., N. Y., N. C., Ohio, Penn., S. C., Tenn., Va., W. Va.; 2nd, Conn., Fla., Iowa, La., Mass., Miss., N. Y., N. C., Ohio, Penn., S. C., Tenn., Va., W. Va.; 3rd, Conn., Dak., Fla., Ill., Ind., Iowa, Kan., La., Me., Mass., Miss., Mo., Neb., N. H., N. Y., N. C., Ohio, Penn., S. C., Tenn.; 4th, Dak., Del., Fla., Ill., Ind., Iowa, Kan., La., Me., Md., Mass., Miss., Mo., Neb., N. H., N. J., N. Y., N. C., Ohio, Penn., Tenn., Vt., Va., W. Va.; 5th, Ala., Conn., Del., Fla., Ill., Iowa, Ind., Kan., Ky., La., Me., Md., Miss., Mich., Mo., N. J., N. Y., N. C., Ohio, Penn., Tenn., Va., Wis., W. Va.; 6th, Conn., Del., Fla., Ga., Ind., Iowa, Ky., La., Md., Mass., Mich., Minn., Miss., N. C., Ohio, S. C., Tenn., Va., Wis.; 7th, Fla., La., Mich., Miss., N. J., N. Y., N. C., Ohio, Penn., S. C., Tenn., Va.; 8th, Dak., Del., Fla., Ind., Iowa, Kan., La., Miss., Mo., Neb., N. J., N. Y., Ohio, S. C., Tenn., Vt.; 9th, Conn., Fla., Ill., Ind., Iowa, Kan., Mass., Mich., N. Y., Ohio, Tenn., Vt., Wis.; 10th, Conn., Dak., Del., Ill., Ind., Iowa, La., Me., Md., Mass., Mich., Miss., Mo., N. H., N. J., N. Y., N. C., Ohio, Penn., Tenn., S. C., Vt., Va., W. Va.; 11th, Conn., Del., Ill., Ind., Iowa, La., Md., Mass., Miss., Neb., N. H., N. J., N. Y., N. C., Ohio, Penn., R. I., Tenn., Vt., Va., W. Va.; 12th, Del., Fla., Ill., Ind., Ind. Ter., Iowa, Kan., La., Md., Mass., Mich., Minn., Miss., Neb., N. J., N. C., Ohio, Penn., S. C., Tenn., Va., W. Va.; 13th, Col., Dak., Fla., Ill., Ind., Iowa, Kan., La., Me., Md., Mich., Miss., Mo., Neb., N. H., N. J., N. Y., N. C., Ohio, Penn., S. C., Tenn., Vt., Va., Wis., W. Va.; 14th, Ark., Conn., Ga., Iowa, Kan., La., Me., Mass., Miss., Neb., N. H., N. Y., N. C., Ohio, Penn., Tenn., Vt., Va., W. Va.; 15th, Ala., Ark., Col., Dak., Ill., Kan., La., Miss., N. J., N. C., S. C., Tenn., Va.; 16th, Col., Dak., Ga., La., Minn., Miss., S. C., Tenn.; 17th, Fla., Ga., Ill., Ind., Iowa, Kan., La., Mich., Minn., Miss., Mo., Neb., Ohio, Tenn., Va., Wis.; 18th, Conn., Dak., Del., Ga., Ill., Iowa, Kan., Md., Mass., Miss., Neb., N. H., N. J., N. Y., Ohio, Penn., Tenn., Va.; 19th, Dak., Del., Iowa, La., Md., Mich., Miss., Neb., N. H., Penn., Tenn., Va., Wis.; 20th, Conn., Del., Ill., Ind., Iowa, Kan., Ky., La., Me., Md., Mass., Mich., Miss., Mo., Neb., Nev., N. H., N. J., N. Y., Ohio, Penn., R. I., Tenn., Vt., Va., W. Va.; 21st, Ala., Ark., Dak., Fla., Ga., Iowa, La., Me., Mass., Miss., Neb., N. C., Penn., S. C., Tenn., Utah, Va.; 22nd, Ala., Ark., Dak., Fla., Ind., Kan., La., Mich., Miss., Neb., Nev., N. J., N. Y., Ohio, Utah, Va.; 23rd, Conn., Del., Iowa, Kan., La., Mass., Neb., N. H., N. J., N. Y., N. C., Ohio, Penn., Texas, Vt., W. Va.; 24th, Col., Ga., Ind. Ter., La., Miss., Nev., N. Y., N. C., Wy. Ter., Texas, S. C.; 25th, Col., Fla., La., Me., Mich., Miss., N. Y., Penn., Texas, Va.; 26th, Dak., Fla., Iowa, Kan., La., Me., Mass., Miss., Neb., N. H.; 27th, Ill., Ind. Ter., Iowa, Kan., Miss., Neb., Tenn., Wis.; 28th, Dak., Del., Ill., Ind., Iowa, La., Miss., Mo., Neb., N. Y., Ohio, Tenn., Va.; 29th, Ark., Fla., Ga., Kan., Ky., La., Miss., Mo., N. C., Ohio, S. C., Tenn., Va., Wis.; 30th, Dak., Del., Fla., Ga., La., Miss., N. J., N. Y., N. C., Ohio, Penn., S. C., Utah, Va., W. Va.; 31st, Col., Dak., Fla., Ga., Ohio, S. C., Wy. Ter.

## OPTICAL PHENOMENA.

*Mirage*.—This phenomenon was observed on the 1st, 5th, 7th, 8th, 13th, and 21st, at New London, Conn.; 15th, 24th, and 28th, at Breckenridge, Minn.; 22nd, and 26th, at Tybee Island, Ga.

*Solar Halos* were observed on the 1st at Cornish, Me., Contoocookville, N. H., Rochester, Eastport, Escanaba, Tybee Island; 2nd, Contoocookville, N. H., Tybee Island; 3rd, Rocky Run, Manitowoc, Wis., Escanaba, Dodge City; 4th, Hennepin, Ill., Purdy, Tenn., Cape Lookout; 5th, Leesburgh, Ind., Cornish, Me., Howard, Neb., Ringgold, Ohio, Purdy, Tenn.; 6th, Ringgold, Ohio; 7th, Gardiner, Me., Ringgold, Ohio, Purdy, Tenn., Rochester, New London; 8th, Contoocookville, N. H., Purdy, Tenn.; 9th, Howard, Neb.; 10th, LeRoy, Kan., Ringgold, Ohio; 11th, Leesburgh, Ind.; 14th, Hennepin, Ill., Fayette, Miss., Howard, Neb., Keokuk; 16th, Corsicana, Smithville; 17th, Rockford, Ill., Carthage, Ohio; 18th, Bethel, Ohio, LeRoy, Wis.; 19th, Smithville; 20th, Standish, Me.; 21st, LeRoy, Wis., Tybee Island, Charleston, Fort Gibson; 22nd, Rochester, North Platte; 23rd, Cairo, St. Louis; 24th, Fayette, Miss., Tybee Island; 25th, Malone, N. Y.; 26th, Ringgold, Ohio, Rochester, Wytheville, Grand Haven, Key West; 27th, Cornish, Me., Waltham, Mass., Contoocookville, Auburn, N. H., Brookhaven, N. Y., Westminster, Vt., Toledo, New London, Fort Gibson; 28th, Independence, Iowa, Eastport, Cape Lookout; 29th, Atlantic City, Tybee Island, Jacksonville, Charleston; 30th, Gardiner, Me., Contoocookville, Auburn, N. H., Ringgold, Ohio, Rochester, Tybee Island, Jacksonville; 31st, Purdy, Tenn., Fort Gibson.

*Lunar Halos* were observed on the 1st at Nottoway, Va., Rochester, Eastport, Knoxville, Wilmington, Pittsburgh; 2nd, Knoxville; 3rd, Purdy, Tenn., LeRoy, Wis., Knoxville, Dodge City, Buffalo, Smithville; 4th, Ruggles, Ohio, Manitowoc, Wis., Cape Henry, Duluth; 5th, Ringgold, Ohio, Bismarck, Cairo, Duluth, Evanston, Smithville; 6th, Purdy, Tenn., Bismarck, Eastport, Morgantown, Alpena, Evanston, Smithville; 7th, Standish, Me., Purdy, Tenn., Rochester, Newport, Wytheville, Morgantown, Evanston, Pittsburgh; 8th, Bismarck, Rochester, New Orleans, Smithville; 9th, Newport, Smithville; 10th, Atlantic City, Newport, Smithville; 12th, Newport; 25th, Evanston; 26th, Dodge City; 27th, Eastport, Smithville; 28th, Newport, Mobile, Smithville; 29th, Fayette, Miss., Waterburgh, N. Y., New Orleans, Buffalo, Evanston; 30th, Fayette, Miss., Wytheville, Evanston, Pittsburgh; 31st, Evanston.

## MISCELLANEOUS PHENOMENA.

*Zoological*.—*Martins* left Bellefontaine, Ohio, 26th. *Grasshoppers* at Richmond, Neb., flying N. on the 2d and 3d, and flying with the wind 26th, 27th, 29th, 30th and 31st. A storm of grasshoppers at Pike's Peak, 11th; swarms of grasshoppers at Yankton, 27th, 28th, 29th, 30th and 31st; numerous at Breckenridge, 10th, 11th and 12th; left, going SE., 13th; appeared again 19th and 23d. First appeared at Pembina, flying NE., 8th and 9th, SE., 11th, 12th, 17th, 20th, and S., 13th; at Virginia City were flying SW. 11th to 20th, and SE. 27th to 31st; much damage done in some localities; at Ft. Sully flying NW., and alighting, 15th; NW., 26th; numerous, 16th, 27th, 28th, 29th, 30th. *Colorado Beetles* numerous on potato vines at Malone, N. Y., 20th; the first potato bug of the "Blue Specie" on the 17th, at Stanley, Kas.; at Auburn, N. H., on potato and tomato vines latter part of month.

*Prairie Fires*.—2d, Breckenridge; 3d, Bismarck; 26th, SE. and SW. of Oregon, Mo.

*Forest Fires*.—15th, 16th, 17th, 22d, Eastport. Freehold, N. J., on the 4th, a large fire was started, and continued for some days, destroying crops, timber, &c.

*Polar Bands* were observed on the 8th at Cape Henry, Va.; 11th, 17th, 24th and 27th, Benettsville, Ky.; 15th, Iowa City; 24th, Carthage, Ohio.

*Meteors*.—Those of the 8th and 9th were unusually brilliant, and attracted general attention; that of the 8th passed in a northwesterly direction, the projection of its path being the trace of a vertical plane passing through St. Paul and Louisville and as it passed over a right line joining Cairo and Detroit, it had an altitude of about one hundred and sixty miles. The observer at Cairo reports "the track of this meteor could be traced by a bright line of fire, which was visible for more than an hour after the meteor disappeared;" the observer at Detroit reports "the meteor first appeared as a star of small magnitude, but became elongated and more brilliant as it pursued its course; it broke, giving off an intense blue light, which was succeeded by a less brilliant greenish light, and this, in turn, succeeded by a white light; the track of the meteor was visible for more than half an hour after the explosion;" the observer at Port Huron reports "this meteor appeared to be about one-fourth the size of the full moon, and illuminated the entire heavens for fully half an hour." The meteor of the 9th, observed generally in the Middle Atlantic and New England States, had the same general course, to the northwest, but its altitude cannot be determined from the reports received.

Meteors, chronologically arranged, were observed as follows: 4th, Tybee Island; 7th, Dubuque; 8th, Port Huron, Cairo, Sandy Hook, Logansport, Grand Haven, Evanstown, Indianapolis, Hennepin, Riley, Lyndon, Carbondale and Friendsville, Ill.; Bloomington, Spiceland and Rising Sun, Ind.; Muscatine, Iowa; Benettsville, Ky.; Detroit, Grand Rapids, Litchfield, Traverse City and Hudson, Mich.; Waterburgh, N. Y.; Bellefontaine, Urbana, Kenton, Jacksonburg and Ringgold, Ohio; York Sulphur Springs, Pa.; Rockwood, Tenn.; Bloomfield, Rocky Run, Manitowoc and Utica, Wis.; 9th, Morgantown, New London, Sandwich and Carbondale, Ill.; Vevay and Wabash, Ind.; Fallston, Md.; Somerset and Fall River, Mass.; Trenton, South Orange and New Germantown, N. J.; Ardenia, Waterburgh, Wappinger's Falls and New York, N. Y.; Carthage, Ohio; Hanover, Pa.; Spartanburg, S. C.; Rockwood, Tenn.; 10th, Dubuque and Afton, Iowa; Corning, Mo.; 11th, Lyndon, Ill.; Corning, Mo.; 12th, Smithville, Newport and Mayport, Fla.; Corning, Mo.; 13th, Evanstown; 15th, Newport, Dodge City, Jacksonville; 16th, Jacksonville; Evanstown; Cresco, Iowa; 17th, Davenport; Lyndon, Ill.; 18th, Smithville; 19th, Davenport; Lyndon, Ill.; 20th, Evanstown, Lyndon, Ill.; Smithville, McMinnville, Tenn.; 21st, Newport; Jacksonville; Utica, Wis.; 22d, Ephrata, Pa.; 24th, Evanstown; Vevay, Ind.; 25th, Davenport; Auburn, N. H.; 26th, Smithville, Davenport; 28th, Dodge City, Jacksonville, Smithville; Ellinwood, Kan.; 29th, Point Pleasant, La.; 30th, Carbondale, Ill., Wooster, Ohio.

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